REMARKS

The Examiner's objections have been carefully noted.

With regard to the rejections under U.S.C. §112 second paragraph, raised in paras. 2, 3 and 4 of the Office Action, claims 3 and 6 have been amended and for the purpose of overcoming those rejections. However, it is believed that claims 3 and 6, as originally presented, were fully compliant with the statute. As regards claim 3, length and width are inherent features of a heart that have antecedent basis in the recitation of a heart. MPEP 2173.05(e). Reference to "a length", as was required to overcome the rejection, might be viewed by some as implying that a heart has more than one length. As regards claim 6, the phrase "the algebraic expression" clearly indicates that refence is being made to the expression that follows immediately thereafter. It is hoped that the addition of "following" will eliminate any question of indefiniteness.

The Examiner has rejected claims 1-4 and 8 under U.S.C. §102(b) as being anticipated by Kayikcioglu ("*Unique determination of shape and area of coronary arterial cross-section from biplane angiograms*"). This rejection is respectfully traversed.

In order to understand why Kayikcioglu is not relevant to the present invention, some brief comments relating to the invention are in order. A principal object of the invention is to produce a pseudo 3-dimensional image of a patient's heart from a pair of angiographic images. It does this by processing all the pixels that are bounded by the patient's heart so as to add depth. This is done by weighting the

intensity of all pixels bounded by the patient's heart by a function z that describes the heart as an ellipsoid, for example, and is used to add a heuristic depth to the 2-dimensional image. Preferably, this approach is applied to a pair of images of the coronary arteries so as to produce a stereoscopic effect. In this case, the pair of images may either be derived from different projections or may be temporally differentiated so as to produce two slightly out of phase images owing to the natural pumping movement of the heart.

Claim 1 and new claim 13 are directed to the principal object of the invention; and claim 8 employs the method of claim 1 on two images so as to produce a stereoscopic effect.

In complete distinction to this, Kayikcioglu describes a method for computing the cross-sectional area and shape of the artery. This is very important for purposes of, for example, three-dimensional reconstruction of the arterial tree. The Examiner has clearly taken note that the article analyzes the artery cross section as an ellipse but appears to have confused the term "ellipse" referring to a planar geometric construct with the term "ellipsoid" which is a volumetric geometric construct obtained by rotating an ellipse through 360°. This being understood, it is to be note that the intensity functions and values referred to by Kayikcioglu all refer to the planar artery cross-section represented by an ellipse. Thus, referring to page 597, lines 4-5 it is stated:

> "In this paper we outline the methodology for finding the shape and the area by using ideal intensity distributions of an elliptical **cross section of coronary artery**."

Likewise, with reference to Equation 2 on page 598 it is stated:

a

> "Let f(x,y) represent the intensity function within the ellipse…".

Since the ellipse is the cross-section of the artery, it may be inferred that an intensity function is not determined for other parts of the images and certainly not for the entire heart surface.

The Examiner states on page 3 of the Office Action that Figure 2 in Kayikcioglu shows the image from two planes from two x-ray sources. This is not disputed but it is not relevant to the invention as claimed since, as noted above, Kayikcioglu makes no suggestion to add depth to an image of coronary arteries bounded by the heart surface so as to render the heart in pseudo 3-D.

Equation 5 in Kayikcioglu is indeed an intensity function as noted by the Examiner on page 3 of the Office Action, but it is determined only for the artery cross section and not for the entire image of the heart.

With regard to the Examiner's rejection of claim 2, reference is made to Kayikcioglu page 597 lines 6-7 under "Methodology" where it is stated:

> "(3) the cross-section of the arteries, including stenotic portions are approximately circular or elliptic".

This rejection of claim 2 is incorrect because it is clear from the very quotation of Kayikcioglu on which the rejection is based, that Kayikcioglu teaches a planar representation of an artery having an elliptical cross-section, which is quite different from an ellipsoidal surface.

With regard to the rejection of claim 3, Kayikcioglu shows an artery whose cross-section is elliptical having an axis

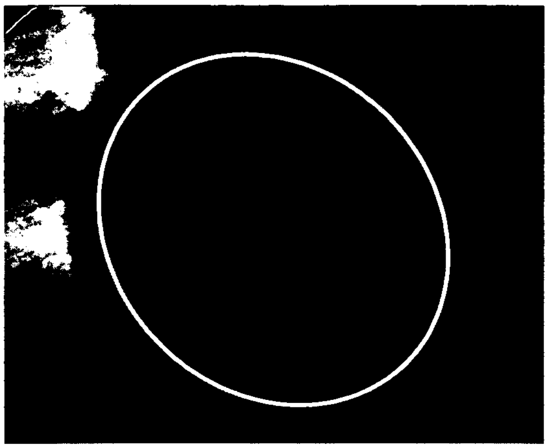
a

that presumably corresponds to the x-ray projection. The axis referred to in claim 3 is of an ellipsoid "coinciding with the length and width, respectively, of the heart in the initial image". The two are entirely different.

The following figure demonstrates Kayikcioglu's approach, where the cross-sectional area of an artery correlates to the integral of intensity (meaning the integral of gray level over the white line in the above image). This area is analyzed as an area of an ellipse and the method described by Kayikcioglu may be employed to determine the true (or close to true) shape of the arterial cross section.

This is quite different from the present application as claimed although possibly the fact that the description uses similar terms to those described by Kayikcioglu may have misled or confused the Examiner. Thus, specifically, while Kayikcioglu analyzes two views of a coronary artery that is elliptical in cross-section, the present invention as defined by claim 1 employs a function z(x,y) to describe **a heart surface** over an initial image so as to encompass the entire heart. In a preferred embodiment of the invention, the surface of heart is

modeled as an ellipsoid as recited in claim 2 and illustrated in the following figure:



Thus, the present invention as claimed, defines a new intensity function I'(x,y) that assigns an intensity value for each pixel based on its initial value (I(x,y)) and – more importantly – on the spatial "position" that this pixel is assigned presuming it is located on a three-dimensional ellipse model (z(x,y)).

Kayikcioglu analyzes the intensity function (gray-level) of the artery's cross section, while in claim 1 of the present application a new intensity function is assigned based on a three-dimensional ellipsoid shape.

The difference between Kayikcioglu and claim 1 is so fundamental that it is respectfully reiterated that Kayikcioglu not only does not anticipate claims 1-4 and 8 as suggested by the Examiner, but does not render them obvious either. There is no teaching in Kayikcioglu to model a heart **surface** as recited in claim 1 and there is nothing in Kayikcioglu that might suggest to one skilled in the art to do so.

a

This being the case, it will be appreciated that Kayikcioglu employs terms that are also used in the claims of the present application to mean entirely different things. For example, the term "ellipse axes" in the context of Kayikcioglu refers to the axes of the arterial cross section which are, in general, the axes of the projection angles, while in the present application they refer to the axes of the heart in the image.

Furthermore, claim 1 of the present application actually relates to only one image - "A method for processing an initial **image** …" While it is true that the invention as defined by claim 8, for example, also contemplates the projection of a pair of images - as does Kayikcioglu - the manner in which these images are processed is fundamentally different to that described by Kayikcioglu in that each image is processed using the technique applied to a single image as recited in claim 1. Thus, even in the case where the invention optionally employs two images, each image requires obtaining a function z(x,y) describing a heart **surface** over the initial image. Moreover, the ellipse and ellipse axis described by Kayikcioglu are defined for each of his two images, while the invention defines an ellipse and ellipse axis for only a single image.

In summary, Kayikcioglu neither anticipates the claims nor renders them obvious. It does not teach or suggest **obtaining a function z(x,y) describing a heart surface over the initial image,** but rather displays a pair of overlapping planar images of arteries having an elliptical cross-section. As opposed to this, the claims of the application are directed to a 3-D image of the heart, which according to claim 2 has an ellipsoidal surface.

a

With regard to the Examiner's rejections of the subsidiary claims, we believe that these are rendered moot in view of the detailed explanations given above and the fact that the base claims are allowable.

New claims 13 to 21 correspond essentially to the features of claims 1 to 7 and 10 and 11, respectively, and define the invention in a manner that is believed is clearly distinguished over Kayikcioglu.

In view of the foregoing, it is requested that the rejections of record be reconsidered and withdrawn, that claims 1-23 be allowed and that the application be found in allowable condition.

If the above amendment should not now place the application in condition for allowance, the Examiner is invited to call undersigned counsel to resolve any remaining issues.

Respectfully submitted,

BROWDY AND NEIMARK, P.L.L.C.
Attorneys for Applicant

By ______________________
Jay M. Finkelstein
Registration No. 21,082

JMF:mch
Telephone No.: (202) 628-5197
Facsimile No.: (202) 737-3528
G:\BN\C\cohn\Evron2a\PTO\AMD 26 MAY 04.doc

a